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KEY TO NATIVE AND CULTIVATED SPECIES OF *ERYTHRINA* (FABACEAE) IN THE USA AND COMMENTS ON NATURALIZATION OF *E. CRISTA-GALLI*

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ABSTRACT

An identification key and brief comments are provided for species of *Erythrina* that are native in the USA — *E. flabelliformis* and *E. herbacea* — as well as non-native ones often cultivated — *E.* x *bidwillii*, *E. caffra*, *E. coralloides*, *E. crista-galli*, *E. falcata*, *E. humeana*, *E. latissima*, *E. lysistemon*, *E. speciosa*, *E.* x *sykesii*, and *E. variegata*. Collections and most reports of *E. crista-galli* in the USA indicate that it is best regarded either as merely persistent in cultivation or else a non-perpetuating waif. There is no evidence that any other species of *Erythrina* is naturalized in the USA.

Erythrina L. comprises 110–130 species (estimates by Krukoff & Barneby 1974 -108; Krukoff 1982 -108; Bruneau 1996 -112; Mackinder 1993 -130; Mackinder et al. 2001 -110; Bean 2008 -120), which are native to the southern USA through Mexico and Central America into South America, southern Africa, and southeast Asia. Molecular studies (Bruneau & Doyle 1993; Bruneau 1996, 1997) have confirmed previous hypotheses of the morphological coherence of the genus and support its monophyly.

Two clearly distinguished species of *Erythrina* are native to the continental USA (Isely 1998): *E. flabelliformis* and *E. herbacea*. Other species are cultivated, particularly in California and Florida, for their brilliant red to scarlet flowers. McClintock (1982) included 37 taxa in her account of those cultivated in California (Table 1). Her earlier key to cultivated *Erythrina* in the USA (McClintock 1953) included 16 taxa (those not included here: *E. acanthocarpa*, *E. americana*, *E. arborescens*, *E. macrophylla*, and *E. zeyheri*,). Good introductions to the commonly cultivated species and many color photos are available on the internet (e.g., Stein 2009; PlantZAfrica.com 2015). Some of these may persist outside of cultivation in the USA but only one, *E. crista-galli*, has been noted or reported (at least as implied) to be naturalized in the USA.

Table 1. *Erythrina* species cultivated in California (McClintock 1982)

E. abyssinica Lam.
E. acanthocarpa E. Meyer
E. americana Miller
E. arborescens Roxb.
E. atitlanensis Krukoff & Barneby
E. barqueroana Krukoff & Barneby
E. x bidwillii Lindley
E. brucei Schweinf.
E. caffra Thunb.
E. chiapasana Krukoff
E. corallodendrum L.
E. coralloides DC.
E. crista-galli L.
E. falcata Benth.
E. flabelliformis Kearney
E. goldmanii Standley
E. guatemalensis Krukoff
E. herbacea L.
E. humeana Spreng.
E. lysistemon Hutch.
E. macrophylla DC.
E. mexicana Krukoff
E. mitis Jacq.
E. peoppigiana (Walp.) O.F. Cook
E. rubrinervia H.B.K.
E. speciosa Andrews
E. standleyana Krukoff
E. steyermarkii Krukoff & Barneby
E. x sykesii Barneby & Krukoff
E. tahitensis Nadeaud
E. tajumulcensis Krukoff & Barneby
E. variegata L.
E. vespertilio Benth.
E. zeyheri Harvey

A key and comments are provided here for *Erythrina* species commonly encountered in the USA, making this information easily available and accompanying a treatment of the native species for the Flora of North America North of Mexico (Nesom submitted). Whether *E. crista-galli* is naturalized in the USA also is considered.

KEY TO NATIVE AND COMMONLY CULTIVATED SPECIES OF *ERYTHRINA* IN THE USA

1. Corollas banners pseudotubular, enclosing keel and wings (pollinated mostly by hummingbirds); species of North America and South America.

2. Perennial herbs or (in southernmost localities) shrubs, 1–2.5(–5) m; leaflet blades ovate-acuminate to hastate-ovate, subtrilobed; native to s and e USA ..... **Erythrina herbacea**
2. Trees or shrubs, 2–8 m; leaflet blades broadly ovate to depressed-ovate, not lobed; native to Arizona and New Mexico, southward into Mexico, or (*E. speciosa*) South America.

3. Terminal leaflets (12–)15–22 cm long; corollas red or pink; calyx tube 10–15 mm long ..... **Erythrina speciosa**
3. Terminal leaflets (3–)5–8.5(11.5) cm long; corollas red; calyx tube 6–8 mm long.

4. Trees 3–5 m; keel petals longer than wings, sagittately auriculate at base, apex dorsally apiculate with projections less than 2 mm long; rachis, pedicels, and calyx tomentellous with reddish to brownish hairs; native to e Mexico, cultivated in the USA .. **Erythrina coralloides**
4. Multi-stemmed shrubs or trees 1.5–5(–9) m; keel petals shorter than or barely equalling wings, not sagittately auriculate at base, apex dorsally caudate with projections 2–5 mm long; rachis, pedicels, and calyx softly short-strigose to tomentellous with pale gray hairs; native to Arizona and New Mexico and southward in western Mexico to Jalisco and Baja California Sur ..... **Erythrina flabelliformis**

1. Corolla banners folded to convex and boat-shaped, usually distinctly separated from keel and wings (pollinated mostly by perching birds, sometimes also by bees); species of South America and Asia, cultivated in the USA.

4. Central leaflet at least as broad as long, broadly ovate to suborbicular, densely tomentose when young, gradually glabrescent at least beneath and becoming coriaceous; calyx spathelike, lobes linear-lanceolate and long-attenuate, 6–8 mm long ..... **Erythrina latissima**
4. Leaflets usually longer than broad, mostly ovate to elliptic, glabrous, usually not coriaceous; calyx campanulate, 2-lipped, or spathelike, teeth or lobes (if present) linear, 1–3 mm long.

5. Multi-stemmed shrubs 1.2–1.5 m tall; flowering with leaves in late summer to fall and early winter; calyx campanulate, apex truncate with short, linear, abruptly emerging teeth ..... **Erythrina humeana**
5. Trees (3–)5–30 m tall, single-stemmed from the base; flowering without leaves spring to early summer; calyx various.

6. Calyces glabrous or glabrate, deeply campanulate with apex entire, weakly 2-lipped if at all; inflorescence of flowers relatively loose along axis; seeds dark brown without red.

7. Inflorescence pendulous, 15–30 cm long, terminal or lateral, with densely-flowered racemes often in groups of 2 or more toward ends of branches, leafless; corollas usually never fully opening (banner covers the stamens and other petals until displaced by a visiting bird); leaflets not reticulately waxy beneath; mature fruits nearly flat, 20–30 mm wide, margins nearly straight ..... **Erythrina falcata**

7. Inflorescence arching, 50–70 cm long, terminal, leafy, or flowers axillary, racemes loosely-flowered; corollas fully opening; leaflets minutely reticulately waxy beneath; mature fruits irregularly cylindric, 12–15 mm wide, shallowly constricted between seeds.

8. Banner 1.5 times longer than wide, not spreading and only slightly reflexed; stamens enclosed by keels except for exserted anthers ..... **Erythrina crista-galli**
8. Banner 2.5 times longer than wide, spreading and reflexed from other parts; stamens enclosed in lower half by keels, upper half-exserted . **Erythrina x bidwillii 'Camdeni'**

6. Calyces densely hairy, prominently spathelike (deeply split on 1 side) or 2-lipped; inflorescence of densely clustered flowers; seeds red to purple or reddish brown.

9. Calyces spathelike, margins with linear lobes 2–3 mm long, floccose-puberulent with stellate hairs; leaf rachises with stellate hairs, glabrescent; mature fruits nearly flat, 15–20(–30) mm wide, very shallowly constricted between seeds, surface prominently coarsely raised-reticulate; mature bark smooth (prickly when young) ..... **Erythrina variegata**
9. Calyces distinctly 2-lipped, lip margins entire, densely and closely villous-puberulent with simple hairs; leaf rachises glabrous; mature fruits (none in *E.* x *sykesii*) 10–15 mm wide, deeply constricted between seeds, surface not at all reticulate; mature bark distinctly furrowed or corky.

10. Flowers sterile, mature fruits not formed; keels separate, ca. 1/2 the length of the banner ..... **Erythrina x sykesii**
10. Flowers fertile; keels fused along lower margin, ca. 1/4–1/3 the length of the banner.

11. Corollas scarlet; banner 2.4–6.8 cm long, 1.2–2.9 cm wide (longer, narrower), relatively straight and folding to enclose the other petals and stamens; flowers declined toward the inflorescence axis ..... **Erythrina lysistemon**
11. Corollas orange-scarlet; banner 3.8–5.4 cm long, 1.5–3.4 cm wide (shorter, broader), curving upward away from other corolla parts and exposing the stamens; flowers spreading away from the inflorescence axis ..... **Erythrina caffra**

Erythrina x bidwillii Lindl. **'Camdeni'** (shrub coral tree, Bidwill's hybrid coral bean, fireman's cap)

Sterile hybrid between *E. crista-galli* and *E. herbacea.* Spreading shrubs or small trees 2–4 meters tall, floering while leafy, deciduous. The original hybrid was made in Australia in about 1840 — distinct forms were segregated from the progeny (Wikipedia 2013). *Erythrina* x *bidwillii* 'Camdeni' (the common one in the USA) is similar to *E. crista-galli* in its perennial woody form, while *E.* x *bidwillii* 'Blakei' follows *E. herbacea* in dying back to a rootstock each year. Increased frost tolerance in the hybrid reflects its heritage from *E. herbacea*, and in Austin, Texas, *E.* x *bidwillii* is said to recover to flowering more quickly than *E. crista-galli* after a frost (San Marcos Growers 2015).

Erythrina caffra Thunb. (coastal coral tree, cream coast coral tree, Kaffir coral tree)

Deciduous to semi-deciduous (leaf drop and flowering sometimes occur at the same time) trees 8–12(–21) meters tall. Native to Mozambique and coastal regions of South Africa, cultivated widely, and reported to be naturalized in India, Australia, and New Zealand. It is the official tree of Los Angeles, California.

Erythrina coralloides DC. (flame coral tree, naked coral tree)

Deciduous, low-spreading trees mostly 3–5 m tall. Native to eastern Mexico (Guanajuato, Hidalgo, México, Nuevo León, Oaxaca, Puebla, San Luis Potosí, Tamaulipas, Veracruz). See Krukoff and Barneby (1974) and McVaugh (1983) for comments on variation within the species.

Erythrina crista-galli L. (crybaby tree, cockspur coral tree, fireman's cap tree)

Deciduous, broadly spreading trees 5–8(–10+) meters tall, called "crybaby tree" because of abundant nectar that sometimes drips from the flowers. Native to South America (Argentina, Brazil, Paraguay, Uruguay) and the national flower of Argentina, Peru, and Uruguay. Widely cultivated in tropical and subtropical regions, naturalized in New Zealand and coastal districts of eastern Australia (Bean 2008).

In Australia, *Erythrina crista-galli* is abundantly naturalized along waterways, in swamps and wetlands, and in urban bushland (Queensland Govt. 2015) — it reproduces by seed and also by branches and stem fragments carried by water and rooting. In Puerto Rico, Liogier (1988, p. 161) noted that it is "occasionally planted and escaped"; Liogier and Martorell (2000, p. 81) noted that it is "occasionally planted and naturalized." It has been planted as a street or garden tree in California since at least 1853 (San Marcos Growers 2015) and also is cultivated in Florida and along the Gulf Coast of the southeastern USA westward to south Texas.

Erythrina crista-galli is one of the hardiest of the coral trees — once established, it tolerates temperatures to 20° F without significant dieback and is root hardy down to 14° F (San Marcos Growers 2015). The combination of cold tolerance, fast growth, and flowering even in young individuals apparently underlie its popularity and wide geographical range of cultivation in the USA.

In a study of the reproductive biology of *Erythrina crista-galli* in Argentina and Uruguay (Galetto et al. 2000), only 6% of flowers set seed in natural populations but almost 93% of recorded flowers were visited by carpenter bees and honeybees, with the rest visited by four species of hummingbirds. The species is self-compatible but seed set and germination are higher in outcrossed flowers.

Erythrina crista-galli naturalized in the USA?

Indications or implications that *Erythrina crista-galli* is naturalized in the southeastern USA (Kartesz 2014; USDA, NRCS 2015 — in Florida, Georgia, Louisiana, and Mississippi) have been picked up and repeated in other literature (e.g., Randall 2012; Queensland Govt. 2015). Various statements (and implications) about the USA plants, however, have been less than explicit.

Weakley (2012, p. 500, citing Isely 1990, 1998 and Kartesz 1999) has noted this regarding *Erythrina crista-galli* as a member of the flora of the southeastern USA: "Cultivated, disturbed areas, roadside ditches." North Carolina is included in Weakley's USA range by a map symbol; his key to species characterizes *E. crista-galli* as a "cultivated tree, persistent."

Isely (1990, p. 66) noted that "Small (1933) reported this species (as *Micropteryx crista-galli*) in waste places, Coastal Plain, Gulf States, and Krukoff and Barneby (1974) listed it from three southern states. Recent scanty documentation in our region is limited to Florida, and true establishment is doubtful." Isely also included *E. variegata* in his treatment, noting that "the species is "cultivated and persistent in urban areas, cp. S. Fla." Isely (1998) again included both non-native species: E *crista-galli*: "intr to s US. S FL, se TX, s CA; reported MS and GA (Krukoff & Barneby 1974). Cult and occasionally persistent in urban areas." And *E. variegata*: "intr in s US. Primarily urban s FL and CA. Cult and persistent."

The current listing of *Erythrina crista-galli* in the Georgia and Mississippi floras apparently is based on information cited in the PLANTS database as "Iowa State [College] Journal of Science 1941." If that citation is correct, then an allusion to the *Erythrina* may exist in one of the doctoral dissertation abstracts published in volumes 15 and 16 of that journal as it is not mentioned in any of the main articles. The species is not listed or mentioned in the Georgia checklist (Duncan & Kartesz 1981) or Georgia atlas (Jones & Coile 1988). The Mississippi checklist (McCook & Kartesz 2000) has included *E. crista-galli* specifically on the basis of the 1941 literature citation.

An early collection from Louisiana by Americus Featherman (NY!, without date or other information) notes that *Erythrina crista-galli* was "naturalized in the streets of Baton Rouge." The species was not listed or mentioned in Featherman's reports on his Louisiana flora survey (1871, 1872), so presumably the collection was made later. Featherman was a member of the Lousiana State University (Baton Rouge) faculty between 1869 and 1872 but he collected plants in Louisiana from 1858 until 1875 (Ewan 2005).

Allen et al. (2002, p. 94) noted that *Erythrina crista-galli* "is cultivated in Louisiana and persists with records from East Baton Rouge, East Carroll, Lafourche, Ouachita, and St. Charles parishes." The species was included for these parishes in the atlas of the Louisiana flora compiled by Thomas and Allen (1997) but it was not included in the atlas of McRoberts (1989). Specimens at NLU of *E. crista-gallii* are all from cultivated plants — 1 from East Carroll Par. in 1973, persistent at an old home site; 4 from Ouachita Par., all from within the city of Monroe, 1958-1983. All Louisiana collections of *E. crista-gallii* currently at LSU represent cultivated plants — East Baton Rouge, Lafourche, and St. Charles parishes; digital images via LSU online database.

As part of the Florida flora, *Erythrina crista-galli* is not documented at FSU, FTG, or USF (collections examined via online herbaria) and it is not included in the Florida Atlas (Wunderlin & Hansen 2013). It is not among the species included by Wunderlin & Hansen (2003) or Nelson (2012). A single individual within the city of Gainesville appears to represent the only documented instance of a plant growing outside of cultivation — it was collected twice in 2009, once in flower and once in fruit.

Florida. Alachua Co.: Gainesville, E side of NW 55th St., just N of 8th Ave, leaning out from woods, individual tree, flowering, 29 May 2009, *Vandiver s.n.* (FLAS, digital image!); Gainesville, E side of NW 55th St, just N of 8th Ave, leaning out from woods, individual tree, fruiting, 10 Jun 2009, *Jacono 742* (FLAS, digital image!).

A collection of *Erythrina crista-galli* made within the city of Houston was noted by the collector to represent an "escape," but there is no evidence or indication that the species has become naturalized there.

Texas. Harris Co.: downtown Houston, intersection of Montrose Blvd and Welch St, escaped into a vacant lot, 5 Aug 1991, *Brown 15516* (NLU, digital image!).

A flowering plant of *Erythrina crista-galli* probably about 2-3 years old was observed (but not vouchered) in 2007 growing where trash had been dumped at the end of a Croatan National Forest Service road near the Newport River estuary in Carteret Co., North Carolina (photos and information from John Fussell, fide Alan Weakley). There has been no further indication that additional plants have appeared at that site.

In sum, flowering plants of *Erythrina crista-galli* are spectacularly conspicuous and would draw the attention of any floristic botanist, but a documenting collection is known for only a few individuals that might have arisen spontaneously outside of cultivation. It is unlikely that the species is naturalized in the USA — most statements to the contrary are based on cultivated plants or those at sites where they persist from cultivation. Even though occasional, apparently spontaneously occurring plants have been encountered, their apparent lack of spread suggests they are better considered as waifs (e.g., Nesom 2000) than as part of the naturalized flora.

Erythrina falcata Benth. (Brazilian coral tree, evergreen coral tree, corticeira-da-serra)

Trees 10–20 meters tall, evergreen to semi-deciduous. Native to Brazil, Paraguay, and Argentina, Peru, and Bolivia (Burkart 1972). Flowering sometimes as early as late winter and continuing into summer, hardy to 20 degrees F. "We consider this tree to be mostly evergreen, though infrequently it can be seen bare when in flower and often there will be leafless sections that

allow the flowers to be better seen." "It is the largest of the coral trees grown in California and has been in cultivation in coastal California since the 1930s. ... This species is too large for many landscapes, ... has been more difficult to vegetatively propagate than other Coral Trees, and seed grown plants do not bloom for many years. More recently we have had more success rooting cuttings of this magnificent species and are able to offer cutting grown plants in limited quantities" (San Marcos Growers 2015). Burkart (1972) observed that flowering in cultivated trees occurred 11 years after being planted from seed, with trees reaching 10 meters tall after 14 years. See Etcheverry and Alemán (2005) for detailed information on reproductive biology.

Erythrina flabelliformis Kearney (coral, western coral bean)

Deciduous, mostly multi-stemmed shrubs 1.5–2 meters tall in the USA but becoming trees up to 9 meters in parts of Mexico. Native to Arizona and New Mexico and southward in western Mexico (Aguascalientes, Baja California Sur, Chihuahua, Durango, Jalisco, Michoacan, Sinaloa, Sonora, Zacatecas).

Erythrina humeana Spreng. (dwarf coral tree, Natal coral tree)

Shrubs 1–3 meters or rarely small trees to 4 meters tall; "Suffrutex with annual stems from a woody rootstock or shrub" (key in Mackinder 1993); "Suffrutex with woody rootstock, rarely a small tree to 4 m tall" (descriptions in Mackinder 1993 and Mackinder et al. 2001). Calyx campanulate, not lipped; corollas scarlet, keel petals fused along lower margins. Native to open grasslands of Swaziland and eastern South Africa. It is "deciduous from winter well into spring but blooms in late summer and fall, a completely different time of year than other coral trees" (San Marcos Growers 2015). The flowers are produced on leafy plants but the long, relatively loose inflorescences are high above the level of the leaves, which are weakly to strongly 3-lobed. Identified as "Erythrina humeana var. raja" and characterized as a "hybrid" by San Marcos Growers (2015), but *Erythrina raja* Hook. f. (= *E. humei* var. *raja* [Hook. f.] Harv.) was described in 1843 from a native plant of Natal.

Erythrina latissima E. Mey. (broad-leaf coral tree)

Deciduous trees 3–8 meters tall. Native to Botswana, Mozambique, Zimbabwe, Swaziland, and eastern South Africa. Characterized especially by densely tomentose stems, leaves, and calyces, large, broad leaves, at least when young, and thick, corky bark.

Erythrina lysistemon Hutch. (common coral tree, lucky bean tree)

Deciduous trees 3–12(–20) meters tall, with gray or gray-brown, smooth (not corky) but prickly bark. Native to Botswana, Malawi, Mozambique, South Africa, Swaziland, Tanzania, and Zimbabwe; naturalized in Australia.

Erythrina speciosa Andrews

Multi-stemmed shrubs or trees 3–5 meters tall, deciduous but less commonly flowering with leaves, crown broadly spreading and loosely open. Native to Brazil; naturalized in Australia (Norfolk Island). Consistently pink-flowered plants are a horticultural selection.

Erythrina x sykesii Krukoff & Barneby

Sterile hybrid apparently of garden origin in New Zealand, the parentage speculative — Krukoff and Barneby (1974) regarded *E. lysistemon* as one of the parents, based on calyx morphology, but found the identity of the second ambiguous; Spencer (2002) believed the parents to be *E. lysistemon* and *E. coralloides*. Deciduous trees 8–12(–15) meters tall with a wide-spreading crown, flowering mostly before the leaves but sometimes continuing after leaves appear; flowers orange, spreading-ascending on the rachis; calyx shallowly 2-lipped, 11–14 mm long. *Erythrina* x *sykesii* has become naturalized in New Zealand and in southern and eastern Australia, where it propagates via root suckers and stem layering (the stems are brittle and shed easily when windy).

Erythrina variegata L. (tiger's claw, lenten tree, coral tree)

Deciduous, fast-growing trees 10–15(–20) meters tall with a spreading crown (except in the cultivar 'Tropic Coral,' which is columnar and evergreen, often used for hedges). The leaves are variable in shape and size and sometimes variegated with yellow or pale green. Native to tropical Asia (Taiwan and southern China, Indonesia, Malaysia, Philippines, Indian Ocean islands, and India) and tropical east Africa. It has been widely introduced in cultivation in coastal areas of the Old World tropics and is commonly grown in the USA, at least in California and Florida.

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